Signal Tower
Delaware, Lackawanna & Western Railroad
Scranton
Lackawanna County
Pennsylvania

HAER No. PA-132I

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PHOTOGRAPHS

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Historic American Engineering Record
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HISTORIC AMERICAN ENGINEERING RECORD

Delaware, Lackawanna & Western Railroad: Scranton Yards Signal Tower

HAER NO. PA-132I

LOCATION: 80 feet southwest of Railroad Alley and Cedar Avenue
Scranton, Lackawanna County, Pennsylvania

UTM: 18/44444/458377
QUAD: Scranton

DATE OF CONSTRUCTION: 1908

ENGINEER/ ARCHITECT: George J. Ray, chief engineer; Frank J. Nies, architect

CONTRACTOR: Delaware, Lackawanna & Western Railroad

PRESENT OWNER: United States Department of the Interior, National Park Service

PRESENT USE: Not in use.

SIGNIFICANCE: The Mattes Street signal tower controlled rail traffic in front of the Scranton passenger station at the eastern end of the yards. The tower was representative of the D,L & W's standardized signal tower design of 1908-1915.

HISTORIANS: Kathryn Steen and Amy Slaton
Delaware, Lackawanna & Western Railroad: Scranton Yards Recording Project, 1989

INTRODUCTION

The Mattes Street signal tower is located on the east side of the Delaware, Lackawanna & Western's yards in Scranton, Pennsylvania. From the tower, the signalman controlled the tracks in front of the passenger station by coordinating interlocking signals, switches, and switch locks. The signalman's duty was to keep trains moving through the Scranton yards as efficiently and smoothly as possible. The Mattes Street tower was constructed in 1908 and was an example of the D,L & W's standardized design for a signal tower.[1]

SIGNALS

The purpose of signalling itself was simple. The goal was to "inform the engineman whether or not he may proceed beyond the signal."[2] For safety purposes, it was desirable to keep a certain minimum distance between trains. Consequently, a signal would inform the train not to pass if another train had recently passed through. Within a railroad yard, there was a concentration of signals that directed the trains along the various tracks to specific destinations.

In the first decade of the 1900s, railroad signalling systems in the United States were not yet fully standardized across the industry.[3] The D,L & W appears to have been typical in its gradual adoption of most standardized signal procedures. Consequently, after the turn of the century, the railroad was phasing out the use of an enclosed disk, or "banjo" signal and moving toward the use of a semaphore signalling system. Basically, the semaphore signal consisted of a wooden or steel blade about seven feet long mounted 20 to 30 feet high on a post to the right of the tracks.[4] In the case of the D,L & W, the standard signals until 1929 were "two-arm, two-position, 60-degrees, lower quadrant, with home and distant indications."[5] "Two-arm" referred to the fact there were two blades on the post, one a few feet above the second. The top blade--the "home signal"--informed the engineman about the section of track immediately in front of him. If the blade was horizontal, that meant the track was occupied and the engineman was not allowed to move his train ahead. If the blade was slanted downward (as they were in "lower quadrant" types) at sixty degrees, the track section just ahead was clear and the train could proceed. The lower blade referred to the section of track beyond the home signal section, or block. Like the home signal, this "distant" signal also had the "two-position" indication--with the blade in a horizontal position or at a sixty-degree slant to the right. Since the distant signal corresponded to a piece of track still several thousand feet away, the horizontal position of a distant signal meant "caution" or "prepare to stop" rather than "stop." The slanted blade, however, was "clear" or "go" for both home and distant signals. The semaphore blades extended to the right of the post in standard practice. Often the distant signal blade had a forked end, while the home signal blade was pointed or arrow-shaped.[6] On the D,L & W, both home and distant blades were yellow.[7]

The D,L & W signals were powered almost exclusively by electric motor. In 1908, the railroad had 897 miles of track equipped with electric motor semaphores.[8] The 1/12 to 1/5 horsepower motors, as well as the batteries, were stored at the base of the pole.[9]

In 1929, the D,L & W line between Elmira, New York, and Scranton switched from lower quadrant, two-position signals to upper quadrant, three-position signals.[10] The upper quadrant system was characterized by the semaphore blade slanting upward to indicate "clear." A horizontal position still indicated "stop." When a signal had three positions, horizontal for "stop," a forty-five degree slant for "caution," and vertical for "clear," this eliminated the need for the distant signal as a signal in the "caution" position indicated the same as the distant signal in a horizontal position.[11] By the 1930s, colored signal lights were installed on the D,L & W between Binghamton and Elmira, New York. On this line, some of the semaphores were removed; others were retained, but in a lesser capacity. By their presence, rather than blade position, the signals indicated an upcoming junction.[12]

AUTOMATIC BLOCK SYSTEM

Signals were located at the beginning of every section, or block, of track. A block in the 1910s would usually span anywhere from 4,000 to 12,000 feet.[13] There was a tendency for blocks on a steeper grade to be shorter. The tracks were divided into blocks to organize train dispatching when several trains ran on the same tracks. Prior to the block system, trains were separated by time intervals. For example, a second train could not leave the station until ten minutes after the first. Trains risked collision if one deviated from its scheduled pace. The block system, however, operated on a space, not a time, interval; if a train occupied a given block, no other trains were allowed into that block of track. Prior to 1900, the signals that granted or denied access to a block were set manually by a telegraph operator at each block signal.[14] In 1872, an electric current was added to the block; a battery started a current flowing through a rail to the back of the block where the circuit was run via wire to the signal. From the signal, the current crossed to the opposite rail and then ran back to the battery, making a long rectangular electric circuit. When no trains were present, the current flowed freely and prompted the signal to show "clear." When a train rolled onto the block, the wheels and axles shorted the circuit and the current would not reach the signal. Consequently, the signal would relay to a following train that the block was occupied. A block system utilizing the electric current was known as the automatic block system.[15]

In 1901, the D,L & W had installed 58 miles of automatic block signalling. A year later that total was 258 miles, placing the D,L & W at the forefront of automatic block installation. Only two other railroads had installed more miles.[16]

Within a railroad yard, traffic direction was generally more complex and less automatic. The signals used in the vicinity of an interlocking plant, such as the Mattes Street tower, differed in theory from regular block signals. Whereas a block signal indicated whether the next block was occupied or not, an interlocking signal indicated whether its corresponding switch was locked "clear" or not. Since the interlocking device prevented two conflicting switches to be set simultaneously, in practice both the block signals and interlocking signals fulfilled the same function: to prevent trains from collision. Interlocking signals essentially indicated the "route" the train was to follow.[17]

Shorter "dwarf" signals were used within yards to direct traffic on side lines. These signals, about four feet tall at their maximum, were visible enough to direct slower moving trains, but short enough to avoid being distractive to main line movements.[18]

INTERLOCKING

The Mattes Street signal tower was one of three interlocking towers serving the Scranton yards. One tower, on Bridge 60, controlled access to the west end of the yards. Another controlled the east end. The Mattes Street tower, the only one of the three towers still standing, was located just east of the main part of the yards and served the passenger station area.[19]

Interlocking centralized control for signals, switches and switch locks. The mechanism made it all but impossible for signals to conflict with switches. Generally, there were two kinds of interlocking: mechanical and power. In 1915, an Interstate Commerce Commission report showed that 80 per cent of interlocking plants were mechanical.[20] Through most of the steam era, it appears, the D,L & W mainly employed the mechanical interlocking. Types of power interlocking included electro-mechanical, electro-pneumatic, and all-electric.[21] According to one contemporary journal article, the D,L & W installed its first electro-pneumatic plant near Buffalo in 1917.[22] However, there is conflicting evidence on the D,L & W's use of power interlocking. The Interstate Commerce Commission inventory of 1918 states that Bridge 60, supporting the interlocking tower on the western side of the yards, was equipped in 1910 with compressed air.[23] Whether this meant pneumatic interlocking was used there remains unclear.

Inside the signal tower was a frame holding a series of levers--forty-seven in the case of the Mattes Street tower.[24] Each lever had a latch or release attached to it that had to be squeezed before the lever would move. Engaging the latch was a "preliminary locking" procedure and prevented the movement of any other levers. After the lever was moved, it locked into place, and the operator could move the next lever in the sequence.[25]

Out of the forty-seven levers, probably the largest number were devoted to signals. The signal levers were interlocked to insure compatibility between home and distant signals; for example, a distant signal would never be set "clear" if the corresponding home signal showed "stop." The lever for the home signal would have to be disengaged before the lever for the distant signal could be moved. Switch levers would probably have formed the second largest group of levers. The switches and signals were interlocked to prevent conflicting directions to the engineman. A closed switch would be accompanied by a signal in the "stop" position. A third type of lever belonged to switch locks. Throwing a switch lock lever locked the lock rod on the switch and made it impossible for a trackman down at the switch to throw it manually.[26] When a frame of interlocking levers was installed, there were often spare levers installed with the others to allow the interlocking plant to expand if necessary.[27]

The levers activated a long series of connections out to the signals, switches, and locks. The switches were probably connected by mechanical means. Small 1- to 2-inch pipes, perhaps containing a wire, either under tension or electrical, left the tower underground and ran to the switches. The signals and switch locks were possibly mechanical, but may have been electrical. The standardized plans for D,L & W interlocking towers show the donduits for the signals, switches, and locks exiting the tower just above ground level.[28] On the Mattes Street tower, there are no indications of holes at ground level, so it is probable that in this more trafficked, urban area, the connections were underground.[29]

There were several D,L & W signal towers contemporary to the Mattes Street tower that left a more complete historical record. The only brand of interlocking mechanism mentioned with the other towers was Saxby and Farmer. Saxby and Farmer were the American producers of the interlocking mechanism invented by John Saxby in England in 1856. The "S & F" machines were the industry standard in the early years of the twentieth century.[30]

INTERIOR OF BUILDING

Most of the action in the signal tower took place on the top floor. The signalman sat at a long desk in front of a bay window and had a clear view of the tracks. Behind the signal operator, in the center of the floor, was the interlocking frame with its forty-seven levers. The interlocking feature of the levers as well as the sheer number of levers made it difficult for the operator to memorize all the sequences necessary for each switch and signal change. Consequently, there may have been a model or diagram showing the locations of all the switches and signals, or instructions listing the necessary steps to attain the desired signal or switch change.[31] The top floor would also probably have had telegraphs and telephones, a clock, and a megaphone.[32] A toilet was in the corner.[33]

The ground floor was a place for the trackmen to seek shelter when they were out in the yards tending the manual switches and moving trains. There were probably lockers and chairs, and mops and brooms.[34]

The basement of a tower typically housed relays and other electrical apparatus. Most interlocking towers also contained a battery for the track circuits that may have been located in the basement.[35]

ARCHITECTURE

The Mattes Street signal tower resembles in almost every detail the Slateford, Pennsylvania, signal tower of 1911, credited to Frank J. Nies, D,L & W architect. This correspondence suggests that the railroad used standardized plans for these towers, adapting their foundations to local conditions. But the standardized buildings are not merely serviceable. They derive their forms--arched windows and peaked, Spanish-tiled roof--as much from contemporary domestic architecture as from the squared-off, monumental industrial architecture of the nearby D,L & W shops, also designed by Nies. The signal towers were visible to passengers and passers-by, and it seems likely that the attractiveness of the towers was a public relations gesture, not unlike the flowers regularly planted around the road's stations (raised in the D,L & W's own greenhouses).[36]

The Mattes Street signal tower is made of reinforced concrete construction, a material favored by D,L & W president William Truesdale for bridges, buildings and other structures.[37] With typical D,L & W economy, worn rails were used to reinforce floors in the signal towers. Though it was converted to use as an electrical substation in the 1950s, and damaged by fire since that time, its exterior remains largely intact, and shows the design decisions of Nies and his supervisors, chief engineers Lincoln Bush (who left the D,L & W in 1909) and his successor George Ray.

The Mattes Street signal tower has wide eves that shield the top-floor windows from rain and glare, but this functional feature is enlivened by detailed supports, and original plans show the presence of Spanish tile on the roof (since replaced). Other details include slightly protruding bands running near the building's base, and surface treatments that seem to be a Nies trademark. An article on Nies's 1913 Bloomfield, New Jersey station describes these treatments: "The surface of each buttress and of the sunken panel between is outlined by a light-toned, fine textured band, two or more inches wide..."[38] Such a band also outlines the windows of the Mattes Street signal tower, and appears here to be bush hammered, rather than rubbed to smoothness, as it is in other Nies buildings for the D,L & W.[39] Rougher textures on the building were probably obtained by sandblasting the dried concrete to reveal aggregate.[40]

Nies's use of concrete at Scranton achieves a variety of aesthetic effects--bluntly utilitarian at the gas house, and domestically attractive in the signal tower--but in each case Nies acknowledged the medium's "unique monolithic nature and resultant distribution of stresses," avoiding what Ada Louise Huxtable called "the curiously anachronistic character" of much turn-of-the-century concrete architecture. She credits factories, especially that of Ernest L. Ransome, with breaking the stylistic mold for concrete construction.[41] It may be that Nies' application to the locomotive shops of the D,L & W prompted his simplified contours for the signal towers. Despite their worked surfaces and homey features, these track-side structures seem solid and functional. Nies' program is nicely summarized by the writer who described the Bloomfield station:

> Delicate profiles, sharp arrisses, undercuttings and acute, reentrant angles were avoided...Neither in general design nor in the details is there any attempt at deception as to identity of material.[42]

Nies's frankness about his materials seems consonant with the D,L

& W 's extensive commitment to concrete, and its nickname of the day, "the reinforced concrete railroad."

NOTES

1.Preston Cook, "D.L. & W. Standard Concrete Tower," Railroad Model Craftsman (July 1982), 74-75.

2.Braman B. Adams, The Block System of Signaling on American Railroads (New York: The Railroad Gazette, 1901), 173.

3.Braman B. Adams and Rodney Hitt, The Railroad Signal Dictionary, first edition (New York: Railroad Age Gazette, 1908), preface.

4.Adams, The Block System of Signalling on American Railroads, 8, 145.

5. J.E.Saunders, Lackawanna Modernizes Signal System for automatic Train Control," Railway Age Vol. 86 (June 29, 1929), 1548; B.T. Anderson, "Signalling on the Lackawanna Cut-Off," Railway Signal Engineer Vol. 9 (July 1916), 197-9.

6.W.H. Elliott, Block and Interlocking Signals (New York: Locomotive Engineering, 1896), 2,7-8,14.

7."Proposed Modification of Stop-and-Proceed Rule," Railway Age Vol. 71 (November 5, 1921), 867-8.

8.Signal Dictionary, preface; and Adams,The Block System of Signalling on American Railroads, 145.

9.Ralph Scott, Automatic Block Signals and Signal Circuits (New York: McGraw-Publishing Company, 1908), 119.

10.Saunders, 1548.

11.Adams, Block, 146.

12.American Railway Association, Description of Continuous Inductive Train Control Systems of the Union Switch and Signal Company, January 1931 Bulletin.

13.William H. Sellew, Railway Maintenance Engineering (New York: D. Van Nostrand Company, 1915), 319.

14.Kenneth L. Van Auken, The Signalman and His Work (Chicago: Brotherhood of Railroad Signalman of America), 13-17.

15. General Railway Signal, Elements of Railway Signaling (Rochester, New York: General Signal Corporation, 1979), 7, 102-106.

16. Adams, Block, 169.

17. Elliott, 143; and American Railway Engineering and Maintenance of Way Association, Manual of Recommended Practice for Railway Engineering and Maintenance of Way (Chicago: Blakely Printing Co., 1905), 73.

18. Elliott, 159.

19. Delaware, Lackawanna and Western List of Officers, Agents, Stations, Equipment, Facilities, Etc. (October 1917), 48.

20. Sellew, 334.

21. Van Auken, 19-20.

22. B.T. Anderson, "New D.L. & W. Interlocking in Buffalo," Railway Signal Engineer Vol. 10, No. 11 (November 1917), 321-323.

23. Interstate Commerce Commission, Inventory of Furniture, Tools and Miscellaneous Items, Valuation Section 21, Account No. 20, (June 30, 1918), 3, 10.

24. D.L. & W. List, 48.

25. Adams, 178.

26. General Railway Signal, 513-4.

27. Anderson, "Signalling," 197-9.

28. Delaware, Lackawanna and Western Railroad Company, Signal Tower at Slateford, Pennsylvania, May 26, 1911 (plan), original plan in private collection of John Willever.

29. E.E. Russell Tratman, Railway Track and Track Work, second edition (New York: The Engineering News Publishing Company, 1901), 249.

30. General Railway Signal, 6-8.

31. Charles Weiss, Practical Railway Maintenance, first edition (New York: McGraw-Hill Book Company, Inc., 1923), 276.

32. I.C.C., "Inventory," 3,10.

33.D,L & W, "Signal Tower" (plan).

34.I.C.C. "Inventory," 3, 10.

35.Anderson, "Signalling," 197-9.

36.Thomas Townsend Taber III and Thomas Townsend Taber, The Delaware, Lackawanna & Western Railroad in the Twentieth Century, two volumes (Muncy, Pennsylvania: Thomas T. Taber III, 1980), vol. I, 32.

37.For information on the D,L & W's use of concrete, see reports on the Gas House and Washington Avenue and Cedar Avenue bridges that accompany this project.

38."The Architectural Treatment of Concrete Surfaces," The American Architect Vol. CIV, No. 1978 (November 19, 1913), 193.

39."The Architectural Treatment," 197.

40.Railway Engineering and Maintenance Cyclopedia, third edition (New York: Simmons-Boardman Publishing Co., 1929), 482.

41.Ada Louise Huxtable, "Concrete Technology: Historical Survey," Progressive Architecture (October 1960), 147.

42."The Architectural Treatment," 198.

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